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Calibration of Micromachined Force Sensors by Gravitational Force on Precision Microspheres STEVEN J. KOCH, University of New Mexico, GAYLE E. THAYER, ALEX D. CORWIN, MAARTEN P. DE BOER, Sandia National Laboratories — To complement the existing tools for applying and measuring piconewton-level forces on biomolecules (e.g. optical tweezers, magnetic tweezers, AFM), we are developing a compliant micromachined spring for simple and direct measurements in an aqueous environment. Accurate calibration of the spring constant is crucial and we will present a gravitational method that uses NIST-traceable size standard microspheres. The method is applicable to calibration of other soft cantilevers of both in-plane and out-of-plane varieties. We affixed two microspheres to the force sensor and measured a deflection per bead of 196 nm ± 6%. Using a weight of 150 pN ± 4.8% per microsphere, we obtained a spring constant of 0.76 pN / nm ± 8%. The method proved simpler and more reliable when compared to two other methods: high resolution SEM and thermal equipartition. The versatility of surface micromachining should enable use of the spring in new platforms for biophysical force measurement, for example on-chip load cells for dynamic DNA stretching.

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